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AN ANALYSIS OF VCR ENGINE USING WATERMELON SEED OIL AND n-BUTANOL AS FUEL ADDITIVE

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ABSTRACT

To study the performance, emission and combustion characteristics of a single cylinder constant speed direct injection diesel engine using Watermelon Seed oil – the output diesel which fuses on various loads and additive n-butanol. An experiment underwent with combinations of different fusions of watermelon seed oil with diesel such as B20, B40 on various loads, and the result of which was compared with pure diesel fuel. The result showed that the Brake Thermal Efficiency (BTE) for watermelon seed oil with additive n-Butanol and its fusion has low BTE that of the diesel. There were a notice of Carbon Monoxide (CO), Hydrocarbon (HC) and NOx emission. There were also a tangible amount of smoke emission and decrease of combustion properties such as high pressure and heat frequency for watermelon seed oil and diesel fusion on full load. The conclusions were likely that the lower blends of watermelon seed oil can be used in diesel engine without any alterations.

***KEYWORDS:** Watermelon Seed Oil, N-Butanol, BTE, HC, CO & Nox*

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Original Article

INTRODUCTION

The significance of diesel is inevitable with regard to its use in transportation industry and various other commercial uses. Being a non renewable resource heading to an imminent extinction, bringing in alternatives would broaden the benefits of country in the aspect of economy and a better social solution. There are already several research works undergone with Methyl Ester of watermelon seed oil confirming this approach of Biodiesel and diesel fusion contributing to this need for alternatives. Also, it is found to be performing well. The various researches are made round the globe on Methyl Ester of Watermelon Seed Oil. The several experiments are made to standardize the Bio diesel and diesel blend. In this project one of such idea is implementing as a new approach to Bio diesel blended diesel is followed to improve its performance. Many results show that the Methyl Ester found in watermelon seed oil is emitting NOx in a higher proportion. The project aims at arriving at the experimental results of emission properties from the fusion of Methyl Ester in watermelon seed oil by adjusting the injection timing of the cylindrical diesel engine. Properties such as BTE and brake energy consumption are to be calculated based on adjusted injection timing and of loads. In addition to this, the alteration of injection timing, on varied loads attributes to calculating the emission properties such as: NOx, CO, CO2. Where the biodiesel fusion being: B20, B40, B60, B80, Injection timing being: 33 degree BTDC, 30 degree BTDC and 27 degree BTDC. The final results are directly compared with that of the diesel. The optimised value is suggested for the better Methyl Ester of

watermelon seed oil based biodiesel.

EXPERIMENTAL METHODOLOGY

The seeds from the natural watermelon fruit available from the plant is taken, collected, stored in a clean environment and dried. The seed is grinded well in order to extract pure solvent agent.

The seed are milled into fine grinded flour after proper peeling off of the pods. The seed should be well grinded in order make it a proper flour. This is kept under 34 degree for about 3 days.

Processing for Extraction

The powdered samples of seed are sun dried and made ready for aqueous extraction under pressure.

The ratio of 10 grams of seed flour with 100 ml distilled water is taken in an extractor (pressurised extractor). The pressurized extractor whose characteristic would follow a principle according to which a supercritical water is formed when heated under 180 degree C at a controlled pressure, possessing the property of Ethanol/ Methanol. A rotary evaporator is used to dry the extracts in a minimal pressure and temperature between 40 and 50 degree C. The remains of the extracts are then used for quantitative estimation of metabolites both primary and secondary.

Quantification of Primary Metabolites

We choose primary metabolites as it possess the characteristics of organic compounds rather than the typical molecular properties contained in other seeds. This mainly helps in achieving the plant pathway for a plant for assimilation, growth and synthesis. To begin with the experimentation, the working conditions of Engine equipments are well checked. The test engine is attributed to tests until it reaches a stable working condition. By now, the engine load is varied to maximized load. The experiment setup is made ready such as the analyser is kept on, dynamometer is kept on. The experimented is then started based on the doers careful practice.

In this research work the watermelon seed oil and biodiesel fusion is taken in the ratio of 20% and 40% volume along with n-Butanol as an additive. The loads in the engine are that of five different levels at varied loads. The levels being: 0, 25, 50, 75, 100 (in percentages). The constant speed of 1500 rpm is adjusted at the various loads of the engine. The load levels are maintained that at each level the air consumption, air and coolant temperature, crack angle, pressure on combustion, emission of HO, CO, NOx and smoke are recorded as data. After this the same experiment is calculated in the normal diesel fuel and the results were observed and compared. The detailed analysis of the data is then discussed in detail.

ENGINE AND EXPERIMENTAL SET UP

The Kirloskar (VCR) rapid cylindrical injection based diesel engine model is used for the experiment which is basically a natural water aspirated engine cooled four strokes diesel engine. To increase the fuel efficiency is the ultimate goal as this has increased competence across the global economy with respect to fuel demand. To evict this problem the Variable Compression Ratio is introduced to meet with fuel efficiency and reduce the CO2, NOx emission. It replaces the traditional fuel with ethanol and LPG. The hydraulic head of the engine model could also be altered according to the desired load and given acceleration.

Figure 1: Experimental Setup

This engine can be used in the all purpose machinery and commercial agricultural use. Several alterations can be made on the engine such as changing the header part and the piston. Load tests are conducted for the following ranges: 3.0 KW, 6.0 KW, 9.0 KW. The most conventional engine timing be 23 degree BTDC. Constant speed should be maintained when varying the loads in order to maintain the fuel flow. The outlet of the combustion chamber should be handled with rods (pushable). To measure the pressure in the cylinder, a piezoelectric transducer is mounted at the head of the cylinder.

The following characteristics are determined: thermal efficiency of brake, combustion delay, heat release and delayed time, both for the setup and the formal diesel engine.

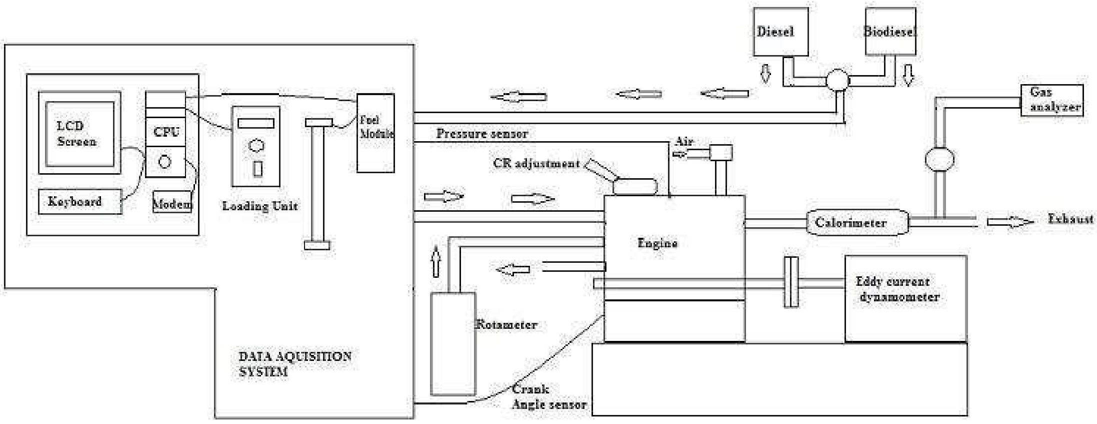

Figure 2: Systematic Setup

Load and Speed Measurements

Loads and Speed calculation are determined where the engine is maintained at a constant of 1500 rpm with varied loads are monitored by digital speed indicator with the help of sensors.

Fuel Consumption Measurement Devices

Fuel consumption is measured using a device which is developed accordingly:

In a panel board a diesel tank is situated and made to flow through the engine. The flow is managed by a cork by making to flow through the burette. The fuel taken at the time of 10cc is noticed and taken as the standard consumption measure.

Exhaust Gas Emission Measurements Devices

The necessary gas emission results are measured for the following gases: CO, HC- These are measured by the gas analyser AVL- 444 D gas analyser. NOx: This gas is measured by the sensor for chemical next situated to the one for Oxygen with regard to its use as catalyst. Smoke: Smoke is measured with the help of a Bosch smoke meter of AVL type. The exhaust gases from the engine are collected through the exhaust pipes to made enter to the NOx analyser. AVL 615 Indimeter software: The A/D data of the input card is measured by this AVL 615 Indimeter software.

Figure 3: Exhaust Gas Analyzer & Smoke Meter

EXPERIMENTAL PROCEDURES

The engine conditions for fuel tanks, coolant oil frequency are checked to start the experiment beforehand. In this, present work the watermelon seed oil is mixed with pure diesel in the volume of 20% & 40% along with n-butanol as additive. The engine setup is made to attain a stable condition and by gradual means the loads are increased. The proper setup and arrangement on the analyser, smoke meter are switched on to measure the results of the experiment to be carried forward. The engine pressure is controlled and the loads are varied to the level in the observant manuals. The speed being 1500 rpm. All the experiment results are observed and compared with that of the diesel engine and the results are used to synthesis the goals.

RESULTS AND DISCUSSIONS

The experiments were done on a single cylinder diesel engine to evaluate the performance, emission and combustion characteristics for the Watermelon seed oil blends along with 10% of additive n-butanol for each blend at unusual load conditions. The measured values are analyzed and presented in this section.

Comparative Statements of NOx Emissions for Bio Fuel

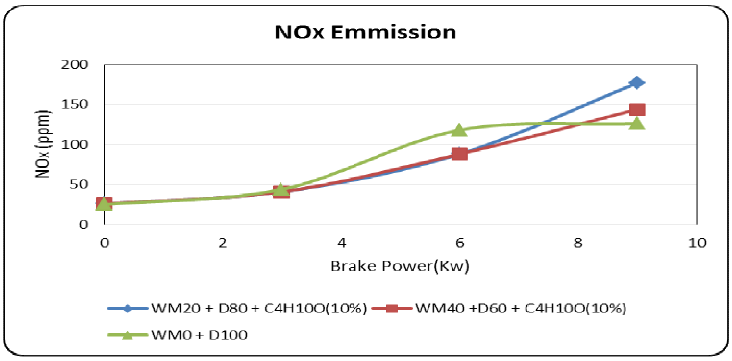

Figure 4

Figure. shows the variation of NOx emission with load. When the load increases NOx emission also increases. For maximum load of 9kg for diesel 126 ppm, WM20% – 144ppm, WM40% – 177 ppm. When compared to diesel, WM20% and WM40% produce slightly high NOx emission for higher loads.

Comparative Statements of HC Emissions for Bio Fuel

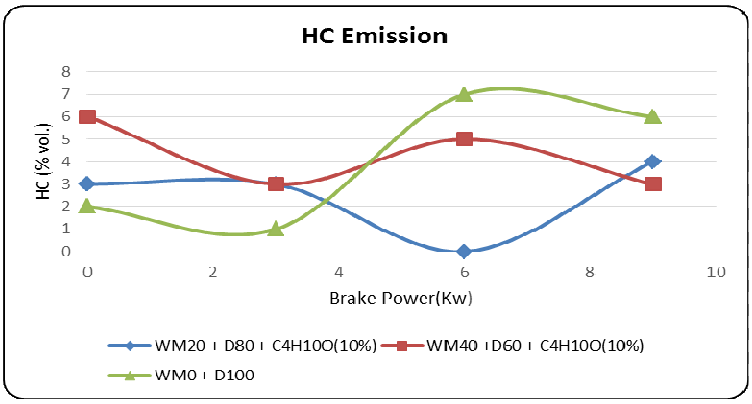

Figure 5

Figure. shows the variation of HC emission with load. When the load increases HC emission gets varied gradually. For maximum load of 9kg for diesel – 6ppm WM20% – 3ppm, WM40% – 4ppm. When compared to diesel, WM20% and WM40% produce less HC emission.

Comparative Statements of CO Emissions for Bio Fuel

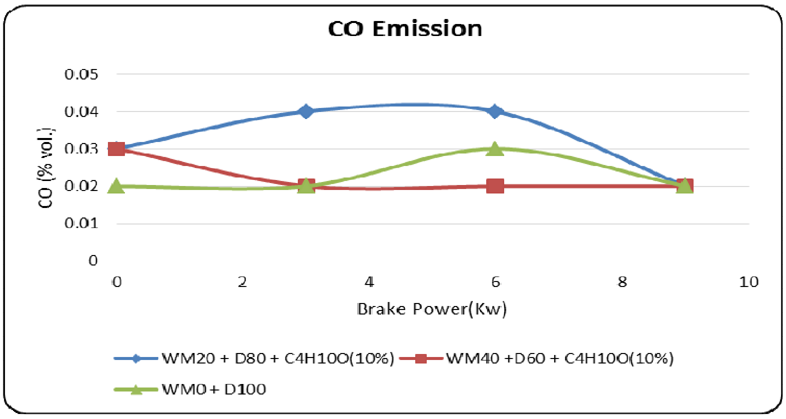

Figure 6

Figure. shows the variation of CO emission with load. When the load increases CO emission keeps varying. For maximum load of 9kg, for diesel – 0.02, WM20% – 0.02%, WM40% – 0.04vol. When compared to diesel, WM20% produces high emission and WM40% produce less CO emission for higher loads respectively.

Comparative Statements of CO_2 Emissions for Bio Fuel

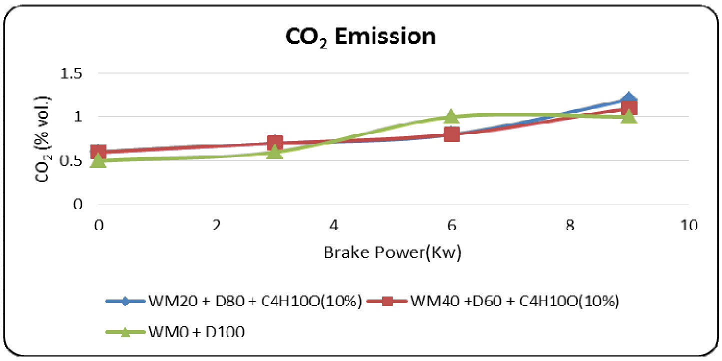

Figure 7

Figure. shows the variation of CO2 emission with load. When the load increases CO_2 emission also increases. For maximum load of 9kg, for diesel – 1.0, WM20% – 1.1 %, WM40% – 1.2% vol. When compared to diesel, WM20% and WM40% approximately maintains the same level of CO_2 emission.

Comparative Statements of Smoke Emissions for Bio Fuel

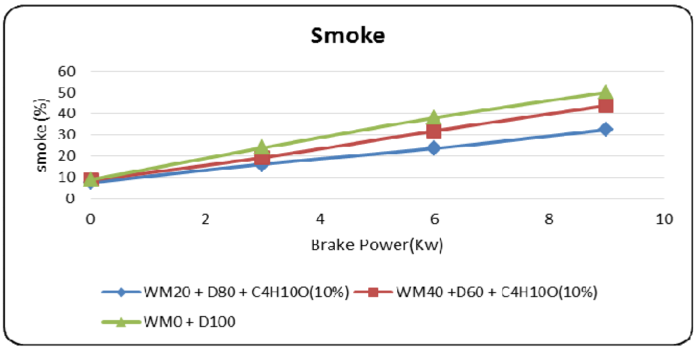

Figure 8

Figure. shows the variation of Smoke opacity with load. When the load increases smoke opacity also increases. For maximum load for diesel – 50.1 %, WM20% – 32.5%, WM40% - 43.9%. When compared to diesel, WM20% produces very less smoke opacity.

Comparative Statements of Brake Thermal Efficiency for Bio Fuel

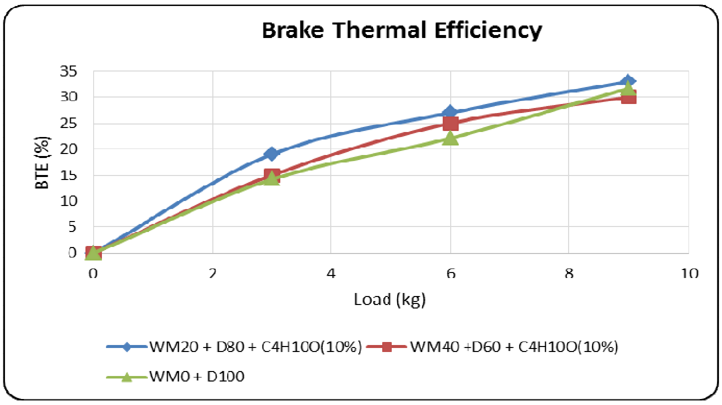

Figure 9

Figure. shows the variation of BTE with load. When the load increases BTE also increases. For maximum load of 9kg, for diesel - 31.7 %, WM20% – 33 %, WM40% – 30%. BTE of WM20% is slightly higher than that of diesel fuel.

Comparative Statements of Specific Fuel Consumption for Bio Fuel

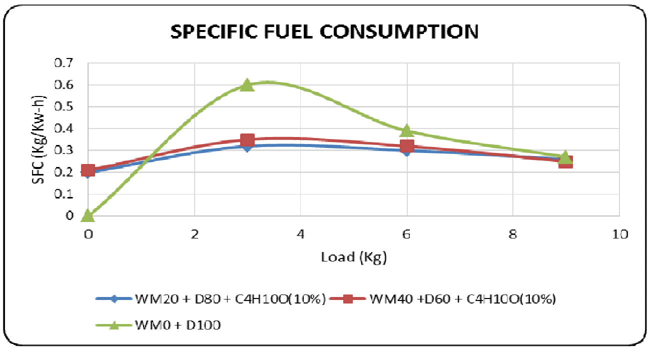

Figure 10

Figure. shows the variation of FC with load. When the load increases FC also increases gradually. For maximum load of 9kg, for diesel - 0.27, B20 – 0.26, B40 – 0.25 kg/kW-hr. FC of both WM20% & WM40% are very much lesser than that of diesel fuel.

CONCLUSIONS

The engine behaviourism is finally proposed to have possessing the ignition and emission properties of diesel engine using watermelon seed oil and n-Butanol additive as a fusion.

Following are our conclusion based on the experimental results obtained.

- The results show that when compared with diesel fuel, brake thermal efficiency for WM40% is as same as diesel and WM20% has slightly higher efficiency for maximum load of 9kg.
- Specific fuel consumption of WM20% & WM40% is very much lesser and maintained in same level for all loads when compared to diesel.
- Carbon monoxide emission is comparatively lower than diesel fuel for WM20% and slightly higher for WM40%.
- Carbon dioxide emission is almost maintained same as that of a diesel fuel. So the CO2 emission is same for WM20% & WM40%.
- Smoke opacity of watermelon seed oil along with 10% additive n-butanol is very less than that of diesel fuel.
- Hydrocarbon emission is found to be very less for WM20% and WM40% when compared with diesel.
- Nitrous oxide emission of Watermelon seed oil along with n-butanol is lesser for lower loads and slightly higher than that of diesel for higher loads.
- In the final observation, the lower blends of the watermelon seed oil and 10% n-Butanol additive fusion is the better replacement for the traditional so far economical diesel engine with zero alteration despite a tangible increased emission.

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